

MAKING POLICY TO ACHIEVE SUSTAINABLE AGRICULTURE

American Farmland Trust

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SUMMARY

American Farmland Trust (AFT) presents a short overview of the environmental sustainability of U.S. agriculture and the policy options to improve it.

WHO WE ARE

American Farmland Trust (AFT) is a nonprofit membership organization with 60 staff members nationwide and 25,000 members dedicated to protecting our nation's strategic agricultural resources. Farmers and conservationists concerned about the rapid loss of U.S. farmland to development established AFT in 1980. Working with farmers and ranchers, political leaders and community activists, AFT has helped to permanently protect more than a million acres of America's best farm and ranch land. Our strategies include transforming federal farm policy to strengthen the future of American agriculture; protecting the best land by supporting effective state and local farmland protection initiatives; assisting states and communities to plan for agriculture in order to keep farming viable and protect working land; and keeping the land healthy and productive by encouraging on-farm stewardship practices that provide public benefits and safeguard America's natural resources.

CURRENT SUSTAINABILITY OF U.S. AGRICULTURE: ENVIRONMENTAL INDICATORS

According to USDA's Economic Research Service (ERS) in 1999, "conclusions regarding the overall sustainability of U.S. agriculture depend on the vision of sustainability a researcher adopts."¹ Aside from agricultural productivity, which continues to rise, indicators like soil erosion and water quality present mixed signals with respect to agricultural sustainability. The ERS report concludes that even as soil continues to erode, the impact of erosion on future agricultural outputs is not significant. Groundwater stocks continue to be depleted, although at slower rates than in the past. And although data are not available to assess changes in water quality, agriculture remains a major contributor to impairments. This is hardly surprising since over half of U.S. lands are in farms. It is also worth noting that that environmental sustainability does not necessarily reduce productivity. The ERS report points out that productivity has been increasing while soil erosion has declined from 3 billion to 2 billion tons/year, groundwater depletion rates have dropped and agriculture has become a net supplier of wetlands. Overall, the ERS concludes "environmental problems exist and the resource base is depreciating but the extent of the effects is in the range that can adequately be addressed by thoughtful policy."

¹ James Hrubovcak, Utpal Vasavada, and Joseph Aldy, July 1999. Green Technologies for a More Sustainable Agriculture. Agriculture Information Bulletin No. (AIB752) 48 pp, July 1999. Available at <http://www.ers.usda.gov/publications/AIB752/>

More recently, in 2003, the Heinz Center began to publish reports on the state of our nation's ecosystems.² Of the 18 ecosystem indicators chosen for agriculture, only nine have adequate data—making it very difficult to establish any trends. The environmental indicators that do have sufficient data show agriculture's contribution to phosphorus and nitrates in streams, croplands most prone to wind and water erosion, and declines over time in wind and water erosion potential.

Any present sustainability in agriculture could be severely challenged in the future. Current attempts to track sustainability do not address the likely impacts of a changing climate on agriculture. The Soil and Water Conservation Society issued a report in January 2003 that looked at just one consequence of a changing climate—increased rain events. The Society predicted increases in soil erosion ranging from 4 percent to 95 percent and increases in runoff from 6 percent to 100 percent on cropland.³

ADOPTION OF CONSERVATION PRACTICES

To indirectly track environmental sustainability, we can measure the adoption of conservation practices that conserve our natural resources. This is an indirect measure because we lack the data necessary to directly link conservation practices to environmental outcomes. To address this need, USDA recently launched the ambitious multi-million dollar Conservation Effects Assessment Program (CEAP) to determine the environmental outcomes of conservation practices.

In a recent report,⁴ USDA's ERS concludes "farm operators have a financial incentive to maintain the quality of their land by limiting soil erosion, avoiding excess chemical inputs and taking other steps to protect soil productivity." However, USDA goes on to point out that "farm operators have little motivation to reduce offsite impacts and farming remains a significant source of sedimentation and nutrient loading in some watersheds." When they looked at participation in USDA conservation programs, they found:

- Farms of all sizes have adopted the relatively inexpensive practices that do not take land out of production (such as conservation tillage, crop rotation and the use of insect-resistant or herbicide tolerant plants), largely without direct financial assistance.
- Operators of small enterprises are less likely to adopt practices requiring extra time or expense, namely precision farming or Integrated Pest Management (IPM) than operators of large enterprises whose primary occupation is farming.

² The State of the Nation's Ecosystems. The Heinz Center for Science, Economics and the Environment. Available at <http://www.heinzctr.org/ecosystems/index.shtml>.

³ Soil and Water Conservation Society. January 2003. Conservation Implications of Climate Change: Soil Erosion and Runoff from Cropland. (www.swcs.org)

⁴ Lambert, Dayton, Patrick Sullivan, Roger Claassen and Linda Foreman. February 2006. Conservation-Compatible Practices and Programs: Who Participates? Available at www.ers.usda.gov/publications/ERR14

- Conservation structures (grass waterways and riparian buffers) and vegetative measures (grasses and cover crops) come at a cost, both for installation and in forgone production. Adoption is varied.
- Larger farms whose operators consider farming their primary occupation are more likely to seek out “working land” programs with the farm bill such as the Environmental Quality Incentives Program (EQIP) that provides cost-share funds to offset the costs of conservation practices. Producers of fruits and vegetables are the significant exception to this finding. They have not generally sought to participate in the working lands programs.
- Intensive use of land retirement is most common among smaller “retired” and “lifestyle” farms with operators who are not dependent on farm income.

Among the implications for policy is the report’s conclusion: “Program incentives that assume that all farmers aim to maximize profits may not be as effective or efficient as flexible incentive structures that can accommodate other farm operator goals, such as timesaving and ease of use.”

These conclusions mirror the findings of a 1999 ERS report on making agriculture more sustainable.⁵ That study looked at the adoption of conservation tillage, IPM, enhanced nutrient management and precision agriculture. It concluded that profitability drove most adoption but not all; that structural barriers such as lack of financial capital or labor availability impeded adoption; that the site specificity of practices meant that no one technology was sustainable on all farms in all regions; and that economic risk may hinder adoption.

FUTURE SUSTAINABILITY – MARKET INDICATORS

At the same time, measures of sustainability must also take the rapidly changing structure of agriculture in this country into account. These changes prompted the American Farm Bureau Federation to convene the Making American Agriculture Productive and Profitable (MAAPP) committee in 2005 to analyze trends out to 2019, presumably so the Federation will have time to react.⁶ In 2002, 143,000 farms produced 75 percent of the value of all agricultural output. It took 2 million farms to produce the remaining 25 percent. In 2019, the MAAPP committee predicts:

- Farming will depend more on rural communities than rural communities depend on farming.
- Global trade will be a key to future profitability but the United States may not be the leader.
- Farmers and ranchers will produce what they can sell—not simply sell what they produce.
- Environmental issues will shift to market-driven actions that achieve environmental benefits.

⁵ James Hrubovcak, Utpal Vasavada, and Joseph Aldy, July 1999. Green Technologies for a More Sustainable Agriculture. Agriculture Information Bulletin No. (AIB752) 48 pp, July 1999. Available at <http://www.ers.usda.gov/publications/AIB752/>

⁶ The report is available at <http://www.fb.org/maapp/>

- Research and technology will be increasingly global in nature.
- The government's role will change due to budget pressures and trade agreements.

CHANGING BEHAVIOR: ENCOURAGING ACTIONS THAT LEAD TO GREATER SUSTAINABILITY

So how can we improve the current state of environmental sustainability in mainstream U.S. agriculture? In 2005, James Salzman published a comprehensive overview of ecosystem services and outlined “the five P’s” that government can use to change landowner behavior: 1) Prescription (command and control regulation); 2) Penalties (taxes and fees); 3) Payment (subsidies, direct payments or tax breaks); 4) Persuasion (information approach with the goal of self regulation); and 5) Property rights (privatization and allocation of the right to a resource). Although there may be a role for all five approaches, AFT prefers to develop incentive-based approaches to regulatory approaches as do most policymakers at present. Nonetheless, all options are on the table.

PRESCRIPTION AND PENALTIES

Although American industry has had to adjust to over three decades of environmental regulations of American industry, U. S. farms have largely avoided significant regulatory impacts—except for regulations governing concentrated animal feeding operations (CAFOs), the Endangered Species Act (ESA) and subsidy based conservation (through conservation compliance).⁷ However, the ESA, with its absolute protection of species, has been used effectively by environmental groups to limit pesticide use and challenge water usage—raising suspicions and driving home a conviction within agriculture that regulatory statutes are often used to resolve unrelated disagreements (prominent examples of this include the 2004 invocation of the ESA in an attempt to halt the registration of pesticides and various cases in which large scale agriculture was accused of infractions under the Clean Water Act or Clean Air Act, when it appeared that the fundamental issue was a disagreement with changing farm structure).⁸

As an alternative to out-and-out regulation with threats of penalties and lawsuits for noncompliance, conservation compliance is a unique policy tool that has changed the behavior of producers since its enactment in the 1985 Farm Bill. To be eligible for Federal agricultural programs, producers must reduce soil erosion, protect wetlands and protect erosion-prone lands. Conservation compliance has been very effective because the geography of commodity program cropland mirrors the location of our highly-erodible lands. This is a policy tool that regulates and penalizes (i.e., withholds benefits) but violations do not imply illegal activity. AFT chronicled the

⁷ Ruhl, J. B. January 2001. Keeping the Agriculture in Sustainable Agriculture: The Challenge of Environmental Policy Reform for Agriculture in the American Midwest. Midwest Commodities and Conservation Initiative. World Wildlife Fund, American Farmland Trust and Winrock International. (contact AFT for more information (tbullock@niu.edu))

⁸ AFBF's MAAPP report, Chapter 6, pg. 97 examines the “sound science” debate from the point of view of conventional agriculture.

reactions to conservation compliance in a series of producer surveys dating from 1992⁹ and found that compliance rates remain high (96 percent) because producers feel that conservation practices improve their bottom-line profits while making them better environmental stewards (and because some fear that non-compliance may be reported, leading to possible loss of benefits and public relation problems).

EXPANDING THE CONSERVATION TOOLBOX

Given the success of conservation compliance provisions, as long as commodity subsidies continue, one approach to improving the sustainability of U.S. agriculture is to expand compliance to address nutrient run-off and leaching. This approach draws on the overlap between commodity program participants and problems and would probably work in most cases because payments generally exceed the costs of addressing nutrient losses. However, the policy might not be as effective in areas with excess manure as manure-related nutrient management solutions tend to be more expensive. USDA offers a different slant on compliance. Mindful of the need to sequester carbon, the agency recently recommended expanding conservation compliance to include “sod saver” measures to discourage conversion of grassland to crop production.

Yet another approach is to establish the “environmental law of farming.” One of the foremost proponents of this approach is J.B. Ruhl, who argues persuasively for a second generation of environmental regulation that relies more heavily on information- and market-based approaches.¹⁰ He points to the ample evidence that crop and livestock production can lead to habitat loss and degradation, soil erosion and sedimentation, water resource depletion, solid and water salinization, chemical releases and animal waste releases. He makes the case that agriculture has been largely exempt from regulations due to explicit exemptions and implicit omissions granted at the federal and state levels from most of the major environmental laws. Ruhl sketches out a new environmental approach for agriculture that includes:

- Using conventional prescriptive regulation for large operations like CAFOs;
- Establishing a national pesticide and fertilizer use reporting system;
- Taxing pesticide and fertilizer use;
- Retiring ecologically important land;
- Requiring participation of all farms in watershed-based pollutant trading.

⁹ AFT surveys include: 1992-93: National: 885 farmers on conservation compliance; 1993-94: Corn Belt: 918 farmers on conservation compliance; 1994-95: National: 1,200 district conservationists: enforcing conservation compliance; 1994-1995: National: 1,009 farmers on potential changes for 1996 Farm Bill; 1995-96: Corn Belt: 1,000 farmers on conservation compliance; 2000-02: National: 1,024 registered voters; 2000-02: Seven regions: 1,189 registered voters; 2000-02: Five states: 330 urban edge landowners/state

¹⁰ Ruhl, J. B. January 2001. Keeping the Agriculture in Sustainable Agriculture: The Challenge of Environmental Policy Reform for Agriculture in the American Midwest. Midwest Commodities and Conservation Initiative. World Wildlife Fund, American Farmland Trust and Winrock International. (contact AFT for more information (tbullock@niu.edu))

Salzman,¹¹ however, warns that both prescriptive measures and financial penalties are primarily one-way discussions—the government telling regulated parties what they can or cannot do and discouraging any flexibility or creativity on the part of the landowner to find the least costly solution.

CONSERVATION INCENTIVES: PAYMENT AND PERSUASION

Payment and persuasion—the use of incentive-based approaches—have traditionally worked for agriculture and are strongly supported by the public, even as farmers’ demand for these programs goes largely unmet.

In 2001, AFT polled 2,213 voters nationwide and found that 85 percent were willing to pay farmers and ranchers for providing environmental benefits.¹² Simultaneously, we found that the federal government was turning away 70 percent of farmers and ranchers applying for federal funds to improve water quality; 90 percent of farmers offering to protect open space by selling their development rights; and 50 percent of farmers seeking information and technical assistance to install conservation practices.

Also, in 2002, AFT polled urban edge agricultural producers and documented their use of best management practices. These producers’ lack of access to cost share funds and technical assistance to implement conservation practices was dramatically illustrated by their stated willingness to adopt new conservation practices if money and technical assistance were available. Our study found that, with government assistance, urban-edge farmers would:

- Increase practices to reduce soil erosion from 52 percent to 81 percent.
- Increase practices to reduce run-off from chemicals from 32 percent to 72 percent.
- Increase practices to reduce run-off from livestock waste from 30 percent to 66 percent.
- Increase practices to minimize overgrazing from 38 percent to 61 percent.
- Increase practices to improve wildlife habitat from 35 percent to 63 percent.
- Increase practices to improve wetlands from 19 percent to 42 percent.

(Note that for any given farm, some practices may not be suitable or needed).

USDA conservation expenditures have steadily increased since the 1985 Farm Bill with a particularly dramatic increase in the 2002 Farm Bill but represent less than

¹¹ Salzman, James. 2005. Creating Markets for Ecosystem Services: Notes from the Field. Available at <http://eprints.law.duke.edu/archive/00001237/>

¹² Esseks, J. Dixon. 2001. Protecting Our Most Valuable Resources: The results of a national public opinion poll. Website presents policy insights from AFT polls in 2001 (of 2,213 voters nationwide) and 2002 surveys of urban edge agricultural landowners – including whether farmers are willing to provide environmental benefits to urban and suburban residents. See <http://www.aftresearch.org/farmbill/report.html> - we are redesigning our website but have left this link in place for the time being)

5 percent of total farm bill outlays. At the same time, more and more farmers have asked for help. As a result, three out of four farms that apply for conservation funding are turned down.

Since the ERS report on sustainability in 1999, several solutions have emerged or been proposed to resolve the barriers identified to the adoption of conservation practices:

- To improve profitability, we can offer greater access to cost-share funds, establish markets for environmental services (see next sections) and expand eco-labels or eco-certification. According to a recent report, programs operating in the United States (including Food Alliance, Forest Stewardship Council, Rainforest Alliance and Protected Harvest) reported certifying a combined 26 million U.S. acres and 216.5 million acres worldwide in 2006.¹³ These organizations lent their "eco-labels" to qualifying products to signify that participating producers met eco-standards including on-site verification of IPM practices. (In comparison, organic certification covered 4 million U.S. acres generating \$14.6 billion in consumer sales in 2005.)
- To overcome structural barriers, we can educate lenders about the need for greater sustainability and address labor shortages.
- To accommodate site specificity, we can decentralize our approach to research, development and technology transfer.
- And to minimize economic risk, we can greatly expand the targeted risk insurance approach pioneered by AFT's Agricultural Conservation Innovation Center.¹⁴

AFT's Recommended Solutions: Based on years of previous research and a concerted 18-month dialogue with over 400 farmers from 48 states, 200 non-farmer stakeholders and 40 policy specialists, early last year AFT released *Agenda 2007*,¹⁵ its recommendations to reform federal farm policy. To strengthen agricultural conservation programs, we recommend expanding, improving and simplifying working lands programs by:

- Increasing the amount of conservation on working lands and reducing the backlog of needs by doubling funding for working lands conservation programs such as EQIP and farmland protection;
- Improving the effectiveness of conservation programs by creating a cooperative conservation program to engage producers and other stakeholders in locally led projects;
- Expanding stewardship by engaging private financial resources in a conservation loan guarantee program;

¹³ IPM Institute News. The IPM Institute of North America. January 2007. Available at http://ipminstitute.org/newsletter/newsletter_v8i1%20.htm

¹⁴ See www.farmland.org/resources/bmpchallenge/default.asp

¹⁵ AFT's vision is for well-managed, protected farm and ranch land that provides open space, clean water, healthy food, wildlife habitat and a renewed connectedness between the farm community and the rest of America. Available at <http://www.farmland.org/programs/campaign/default.asp>

- Strengthening delivery of technical assistance; and
- Simplifying the conservation application process and improve environmental performance.

USDA's Recommendations: USDA's 2007 Farm Bill recommendations released last month recommend a significant consolidation of programs to simplify and streamline conservation activities, reduce redundancies and produce more cost-effective environmental benefits. USDA also recommends taking some first steps towards developing private markets for environmental services.

HARNESSING PROPERTY RIGHTS AND PUBLIC DEMAND: ENVIRONMENTAL SERVICES

Yet another approach to improving sustainability, and perhaps the most promising long term, is to harness property rights and to create the markets that allow farmers to “sell” the environmental services they can provide.

The idea of “green payments” for farmers arose in the late 1980s. AFT began to look at the feasibility of green payments in 1994 but in that era, the hurdles seemed insurmountable. The concept of paying farmers for environmental benefits, however, edged closer into policy with the passage of the Conservation Security Program in the 2002 Farm Bill. This modest conservation program awards producers for levels of environmental stewardship. In recent years, tremendous advances have been made in the science, economic valuation, institutional design and social capacity needed for ecosystem-service conservation.¹⁶ In particular, the Millennium Ecosystem Assessment (MA), an international effort to assess the consequences of ecosystem change for human well-being, helped delineate ecosystem services.¹⁷ From 2001 to 2005, the MA involved the work of more than 1,360 experts worldwide. Their findings provide a state-of-the-art scientific appraisal of the condition and trends in the world's ecosystems and the services they provide, as well as the scientific basis for action to conserve and use them sustainably. The MA identifies four categories of ecosystem services: 1) provisioning (e.g., timber, food); 2) regulating (e.g., climate, floods); 3) supporting (e.g., pollination and pest control for food production); and 4) cultural (e.g., serenity, inspiration).

The marketplace and federal subsidies currently recognize and reward provisioning services (food and fiber) offered by agriculture but “do not consider the value a farmer provides when he leaves a stream bank intact as habitat for native plants and wildlife; when he replaces an old almond harvester that still does the job, with a new one that produces less pollution; or when she puts water back in her rice field after

¹⁶ Chan, Kai M., M. Rebecca Shaw, David R. Cameron, Emma C. Underwood and Gretchen Daily. November 2006. Conservation Planning for Ecosystem Services. *PloS Biology* Volume 4, No. 11, e379; pp. 2138-2152. Available at www.plosbiology.org.

¹⁷ The Millennium Ecosystem Assessment Reports are available at <http://www.maweb.org/en/index.aspx>

harvest to provide a safe stopover for migrating snow geese.”¹⁸ These authors go on to state that “Indeed, the biggest market failure of all is that farmland is more valuable for development than agriculture, pressuring farmers to sell—forever foreclosing the possibility of good land stewardship and its environmental benefits, and compromising the nation's ability to feed ourselves.”

For agriculture, the Conservation Reserve Program offers a primer in ecosystem services: retiring cropland reduces soil erosion, decreases nutrient, pesticide and sediment loadings and provides permanent grass and tree cover. These decreased loadings, in turn, improve water quality and the plantings provide wildlife habitat. The resulting services are delivery of cleaner water and the presence of more wildlife.

AFT’s vision is one of farms providing ecosystem services along with food and fiber. These services have the advantages of broad public support, of being considered “green box” (acceptable subsidies) by the World Trade Organization, and of allowing farmers to “sell” environmental services much like they sell agricultural products to provide a steady, reliable stream of revenue.¹⁹ In listening sessions that AFT held with producers around the country in 2005 to help shape our recommendations for the 2007 Farm Bill, the idea of offering ecosystem services appealed to most of the participants. Similar positive reactions were captured in the USDA listening sessions of 2006.

As a result, AFT’s 2007 Farm Bill recommendations include the phasing in of “green payments” to all agricultural producers who manage land and provide environmental benefits based on a simple, transparent and reliable measure of environmental performance. These payments would reward environmental performance already attained, in contrast to conservation cost-share programs, such as EQIP, that provide funds to improve environmental performance.

The possibility of offering ecosystem services took another step closer to acceptance when the American Farm Bureau Federation acknowledged the emergence of market-based initiatives to address environmental problems and manage natural resources in their MAAPP report mentioned above. The report describes the “exciting” opportunities of eco-branding, carbon trading and wetland mitigation banking and states that “utilizing markets for environmental purposes encourages creativity and decentralized problem solving, provides incentives through profits to discover and satisfies consumer wants and provides incentives to do more with less. The report goes on to say: “establishment of these markets presents opportunities to reduce inefficient regulatory burdens and develop new markets for services provided by agriculture. They are a way for the private sector to compensate landowners for environmental benefits provided by conservation practices.” However, this is not

¹⁸ from [California’s stake in farm bill debate](http://www.sfgate.com/cgi-bin/article.cgi?file=/chronicle/archive/2007/01/24/EDG56N75H21.DTL). Richard E. Rominger, Tom Nassif, January 24, 2007 <http://www.sfgate.com/cgi-bin/article.cgi?file=/chronicle/archive/2007/01/24/EDG56N75H21.DTL>

¹⁹ Salzman, James. 2005. *Creating Markets for Ecosystem Services*. Available at <http://eprints.law.duke.edu/archive/00001237/>

exactly “irrational exuberance” on the part of Farm Bureau. The report cautions that “it would be useful for those involved in developing markets if they could clearly understand how much political and regulatory reform is needed to stimulate supply and demand and make the markets work.”

The USDA recommendations for the 2007 Farm Bill also reflect this cautious optimism.²⁰ The recommendations introduce market-based auction mechanisms and local bidding pools to allocate conservation funds based on cost per environmental benefit and create stronger incentives for private markets in ecosystem services (including increased wildlife and wetland habitat, water-filtration, and carbon sequestration). More specifically, the USDA states "while private markets for environmental goods and services are emerging, their viability has been hampered by several barriers including; high transaction costs, the small quantity of benefits that can be provided by individual farmers or landowners, performance risks and liability, and uncertainties in quantifying benefits... New authorities could overcome these barriers and promote the establishment of markets for agricultural and forestry conservation activities." To jump-start this approach, USDA proposes that \$50 million in "mandatory" funding to "be utilized to develop uniform standards for quantifying environmental services; establish credit registries; and offer credit audit and certification services."

Currently, there are a number of pilot programs putting ecosystem services to the test.²¹ In the United States, 40 water quality trading programs are reducing pollutant runoff (nitrates and phosphorus) and 22 of these programs are allowing trades with agriculture. There are also pilot programs to reduce greenhouse gas emissions—chiefly through carbon trading.

NEW POTENTIAL OF ECOSYSTEM SERVICES FOR CLIMATE CHANGE, WETLAND FUNCTION AND WILDLIFE HABITAT

Several reports have concluded that climate change is the environmental problem most suitable for creating a market. A recent report from the Pew Center on Global Climate Change documents the significant role that U.S. agriculture can play in migrating global climate change.²² If farmers widely adopt best management techniques to store carbon and reduce nitrous oxide and methane emissions, aggregate U.S. greenhouse gas (GHG) emissions could be reduced by 5 percent to 14 percent. [Also of note, biofuels could displace a significant fraction of fossil fuels and reduce U.S. GHG by 9 percent to 24 percent.]

²⁰ Available at

http://www.usda.gov/wps/portal/tut/p/s.7.0.A/7.0.1UH?navid=FARM_BILL_FORUMS&navtype=SU

²¹ See <http://ecosystemmarketplace.com/index.php> for information on markets and payment schemes for ecosystem services.

²² Paustian, Keith, John M. Antle, John Sheehan and Eldor A. Paul. September 2006. Agriculture's Role in Greenhouse Gas Mitigation. Pew Center on Global Climate Change. Available at http://www.pewclimate.org/global-warming-in-depth/all_reports/agriculture_s_role_mitigation/index.cfm

Restoration of wetland functions may provide yet another market (via wetlands mitigation banks). About 100 million acres of wetlands, 45 percent of the initial base, were converted between 1780 and 1990. And wildlife habitat is yet another service that could reap dollars for enterprising farmers. However, there are a number of obstacles to overcome—including low demand for services (unless accompanied by regulations that create the market, probably by putting a cap on carbon emissions and thus “encouraging” industry to buy “credits” from agriculture to continue polluting); difficulty in measuring quantity of services (scientific uncertainty) that may lead to high transaction costs; and the real reluctance of farmers to participate in a program that is partly regulatory, even with compensation. Farmers are afraid that the information they share may lead to regulations—and it does not help their peace of mind to know that the leading environmental groups involved in setting up trading programs are some of their traditional foes.

THE NEXT GENERATION: ECOSYSTEM MULTIPLE MARKETS

Although markets for individual environmental services are currently being tested on a small scale, the concept of ecosystem multiple markets is just off the drawing board. This approach is based on the projection that agricultural practices may affect multiple environmental goods and services and that optimizing the services that farms provide requires a comprehensive evaluation of a complex set of environmental interactions. For example, many of the agricultural practices that preserve and enhance storage of carbon in the soil also improve environmental quality by reducing farm-generated non-point source pollution. A recent study confirmed the substantial overlap of practices that store more carbon on agricultural land with practices that improve water quality, finding that when these practices are implemented, water quality improves nationally by 2 percent.²³ This is a significant enough improvement to move most streams and rivers into the “swimmable” range.

For cropland, the activities with highest potential for storing carbon are afforestation, conversion to perennial grasses and switching from conventional tillage to conservation tillage. Other activities include changing crop rotations, expanding use of winter cover crops, eliminating periods of summer fallow, changing fertilizer management, using more organic soil amendments (including manure, sludge and byproducts), improving irrigation methods, shifting land to conservation buffers and restoring wetlands. On the other hand, while a practice such as irrigation can increase soil carbon, the increased CO₂ emissions due to energy used in pumping, and the increased N₂O emissions due to increased fertilizer use may negate much of the gain.

Kieser and Associates, an environmental science and engineering consulting firm, analyzed the ecosystem service market for the Environmental Trading network and

²³ Pattanayak, S.K., B. A. McCarl, A. J. Sommer, B.C. Murray, T. Bondelid, D. Gillig and B. Deangelo. 2004. Water Quality Co-Effects of Greenhouse Gas Mitigation in U.S. Agriculture. *Climate Change XXX*. 32 pp.

reported back on this concept in 2004.²⁴ They thoroughly examine the potential of multiple environmental commodities markets to support restoration projects in the Great Lakes region. They divide agriculture's "environmental commodities" into two categories: Category 1 is comprised of surplus pollution reductions generated by sound management practices, improvements in abatement technology and restoration of natural abatement mechanisms (e.g., wetland); and Category 2 is comprised of services, environmental and/or economic, provided by an ecosystem. There is no clear boundary between the categories. For example, a farmer adopts erosion control best management practices that, in turn, generate sediment credits that can be sold as Category 1 credits. As a result, the lake that was receiving muddy waters downstream from his or her farm now has cleaner water, generating Category 2 benefits. Category 1 benefits include water quality trading credits (nitrogen, phosphorus, sediment), greenhouse gases credits and acid rain gases credits. Category 2 commodities include habitat for endangered and threatened species, recreational opportunities, development rights and flood storage. The healthier the ecosystem, the more benefits it produces. The report goes on to consider the ups and downs of selling credits for greenhouse gas emission reductions, nutrient or sediment reductions (water quality credits), wetlands and wildlife habitat creation in local, regional or global environmental markets.

More recently, Chan et al (November 2006) mapped and modeled ecosystem services to explore the trade-offs and opportunities for aligning conservation goals with biodiversity in California's Central Coast region.²⁵ This study modeled six ecosystem services (carbon storage, crop pollination, flood control, forage production, outdoor recreation and water provision), providing a good overview of the complexity of the challenge ahead.

AFT is now piloting an approach to harnessing the multiple ecosystem services of farms in the Minnesota River watershed. Pending funding, we hope to expand our pilot projects to other regions. With partners, through this pilot AFT is helping farmers adopt Best Management Practices (BMPs) by addressing economic risks through targeted insurance and guarantee payments²⁶ and developing a system of water quality trading credits and other credits. We expect to improve water quality and agricultural profitability in the Minnesota River water basin.

As in many watersheds emptying into the Mississippi River water basin, farmers in our project area are devoting more acres to corn to take advantage of the rapidly burgeoning ethanol markets. To provide incentives for farmers to employ all relevant BMPs, even as they ramp up corn production, we will track multiple environmental benefits and environmental services that can be delivered by farmers

²⁴ Kieser and Associates, April 2004. Ecosystem Multiple Markets: A White Paper. Available at www.envtn.org/etn_projects.htm#emms

²⁵ Chan, Kai M., M. Rebecca Shaw, David R. Cameron, Emma C. Underwood and Gretchen Daily. November 2006. Conservation Planning for Ecosystem Services. PloS Biology Volume 4, No. 11, e379; pp. 2138-2152. Available at www.plosbiology.org.

²⁶ Available at www.farmland.org/resources/bmpchallenge/default.asp

and sold as credits to bring funds into the system (nutrient and sediment reduction, hydrology restoration, greenhouse gas sequestration and creation of new wildlife habitat). We will also work with a third party certifier to develop certification standards for the sustainable production of biofuel crops (support of sustainable biofuels is a social responsibility initiative for some major corporations and, perhaps, some ethanol plants). With help from Michigan State University, we will continue developing ecological indicators that can help farmers track the ecological health of their system. To minimize risks to producers who follow sustainable guidelines and reduce their use of nitrogen and phosphorus, we will offer targeted risk insurance through AFT's Agricultural Conservation Innovation Center. And finally, AFT and our partners will explore policy options at both the state and federal levels to support these new approaches.

If the efforts to establish markets for environmental services are successful, the farm of the future will still produce multiple commodities, but they may have a new look. Salzman (2005) provided an intriguing look at a future farm in Australia. Along those lines, we can envision a similar farm in the United States. Today that farm is growing corn for the world market (95 percent of its receipts) and some timber for pulp and paper (5 percent of its receipts). In the future, that same farm could be making its money selling:

- Corn for world markets (30 percent)
- Corn stover for biofuel plant (15 percent)
- Timber for pulp and paper (20 percent)
- Wetlands credits for developers (10 percent)
- Flood control credits for water district (7 percent)
- Water quality trading credits for water supplier (8 percent)
- Biodiversity credits for an NGO (5 percent)
- Carbon credits for a power company (5 percent)

CONCLUSION

The environmental sustainability of U.S. agriculture is increasing, although we still lack the mass and quality of data necessary to convincingly track trends. Just the sheer land mass occupied by agriculture in this country means its environmental impacts, positive and negative, will be felt. With climate change, increases in severe weather events will certainly put our sustainability to the test with the potential increases in erosion ranging from 4 percent to 95 percent and increases in runoff ranging from 6 percent to 100 percent.

We have a lot of policy tools available to improve agriculture's environmental sustainability but implementing any of these tools (prescription and penalties, payment and persuasion or harnessing property rights) will require political will and support from conventional agriculture and the industries that support it.

The current focus on climate change coupled with the search for energy alternatives puts a spotlight on agriculture. This may provide us with just the opportunity we

Additional materials available at: www.aftresearch.org/aaas

need to harness property rights in the form of ecosystem services that agriculture can deliver and help us take sustainability to a new level.